

Mission

- To deploy a suite of instruments at fixed and drifting locations above the earth in some climatologically important regions
- To collect a well-defined *time series* of atmospheric radiative transport data
- To make observations on the scale of a General Circulation Model (GCM) grid box, so as to define the physics underlying some of the important parameterizations in the GCM's used in climate change.

Science Questions

- What is the high-frequency dynamics of ERB and its impact on global and regional climate?
- How well can we model the ERB at TOA and surface (including spectral and angular variations) given vertical profile information?
- What is the interaction of ERB with hydrological cycle in some poorly understood regimes, such as ERB drift in the tropics and stratospheric H₂O

Examples of Scientific Themes:

- Upper boundary problem (radiation balance)
- Climate forcing (trace gases, aerosol, cloud, land cover change, etc.)
- Cloud parameterizations (sub-scale variability, temporal variability, cloud system evolution, etc.)
- Changes in stratosphere (H₂O, O₃,...)
- Monitoring special events (hurricanes, volcano,

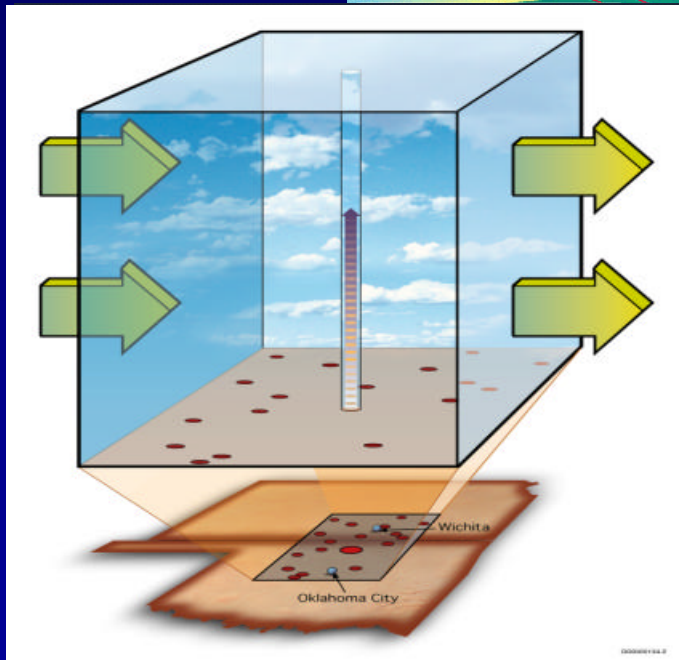
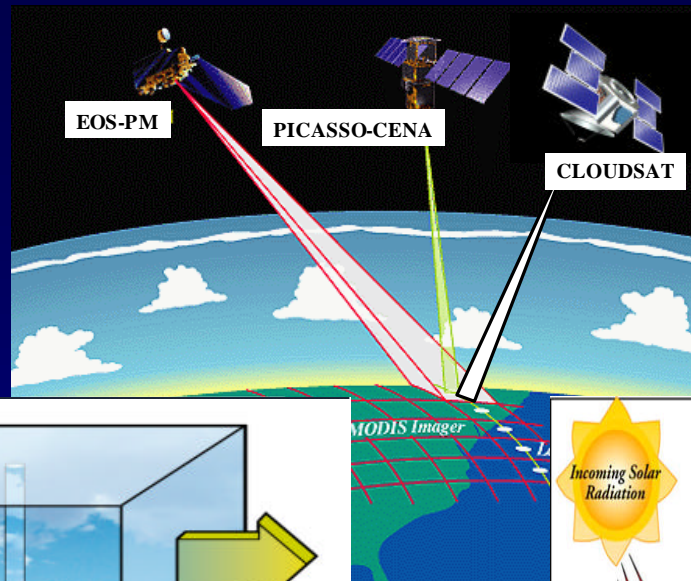
Variables required to be observed:

- TOA and Surface Radiative Irradiance and Radiance (broadband & spectral)
- Atmospheric Flux Divergence
- Profiles of atmospheric species (T, P, u,v,h, O₃)
- Profiles of radiative active agents (water vapor, aerosol, cloud)
- surface (albedo, emissivity)

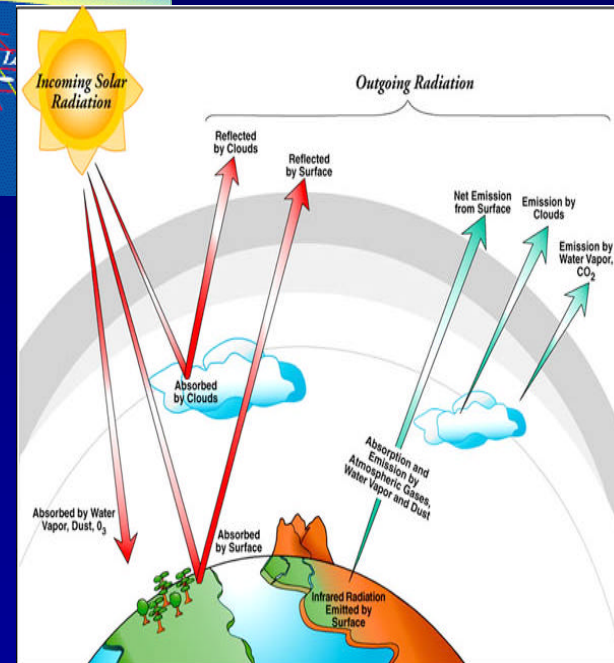
Instrumentation

- Broad-band and narrow-band radiometers (solar and infrared radiation); WFV, Scanning, CCD Imager, ?
- Cloud Profile Radar (cloud properties), 35, 95 GHz or else?
- Lidar (pulsed laser; particle and thin cloud properties)
- Sky imagers (cloud cover)
- Microwave radiometer (water vapor and liquid water)
- UAV and radiosounding (temp, humidity, winds)

Satellite validation



Single-Column Modeling



Radiative closure

Unique and Complementary Features

Uniqueness:

- Continuous operation at fixed locations
- Synergetic observations of multiple instruments
- Capability of large payload (relative to satellite)?

Complementary

To ground-based observation

- Provide the upper-boundary and profile information

To space-based observation

- Provide continuous and intermediate platform

Programmatic Questions:

- What science questions may be uniquely addressed by the new stratospheric platforms?
- What instruments can be readily deployed, what will be available in the near future, and what new technologies need to be developed to address these questions?
- To what extent will observations from the new stratospheric platforms complement and support existing satellite measurements, and to what extent will they provide new independent information?
- 4. What impact will the new observations have on resolving some of the key issues concerning global and regional climate?

Facilitate satellite programs

- **Provide a platform for dry-run of any new sensors**
- **Provide a validation tool for the following sensors and new ones:**
 - **EOS-1 (TERRA) platform: MISR** (Multi-angle Imaging SpectroRadiometer), **CERES** (Clouds and Earth's Radiant Energy System), **MODIS** (Moderate Resolution Imaging Spectrometer), all use the 3 ARM sites as primary validation
 - **EOS-2 (AQUA) platform: MODIS, AIRS** (Atmospheric Infrared Sounder) will use for ARM sites for validation; AIRS paying for sondes launched at site overpasses for validation
 - **CLOUDSAT** validation

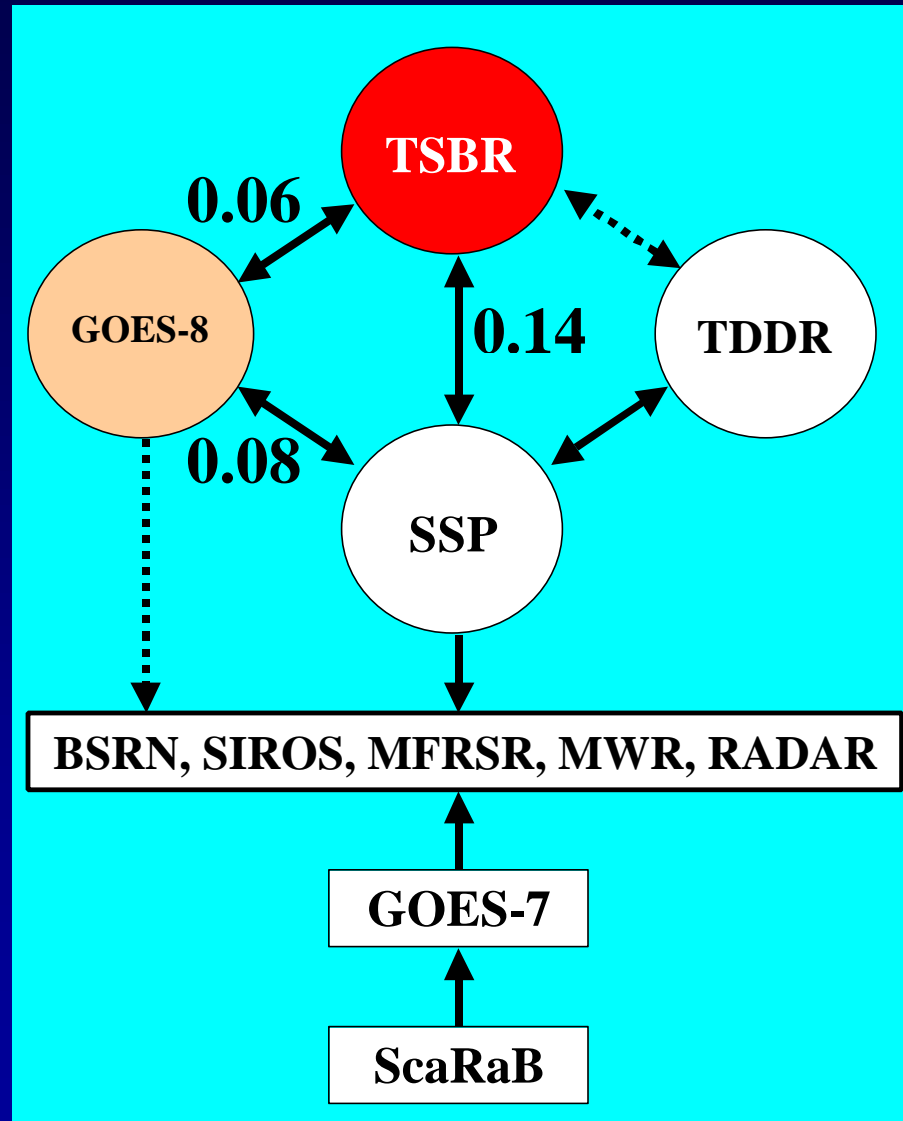
Closure Problem

- Continuous constraint at the TOA
- Monitor the site behavior well enough
- IOP campaigns to gather complimentary information
- Flexible FOV to match grid-cell of GCM or meso-scale models

Deployment



An example of instrument consistency test



VI: Atmosphere & Surface Constrained

Input Variables to MODTRAN-4 (SGP)

Atmospheric profiles: radiosonde soundings

Total water vapour and liquid water: microwave

Cloud base height: laser ceilometer

Cloud top height: cloud radar reflectivity

Cloud optical depth: transmittance at 500nm.

Cloud effective radius: inferred from LWP and tau

Cloud liquid water content profiles: Microwave rad

Ozone column amount: TOMS data

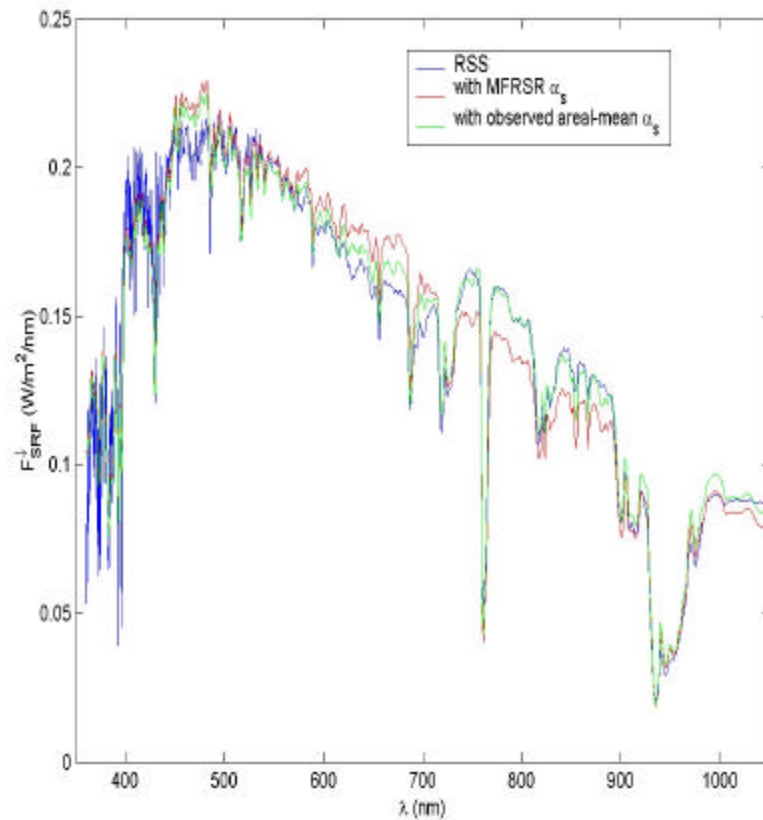
Surface spectral albedo: Mapping

Output to be Compared with MODTRAN-4

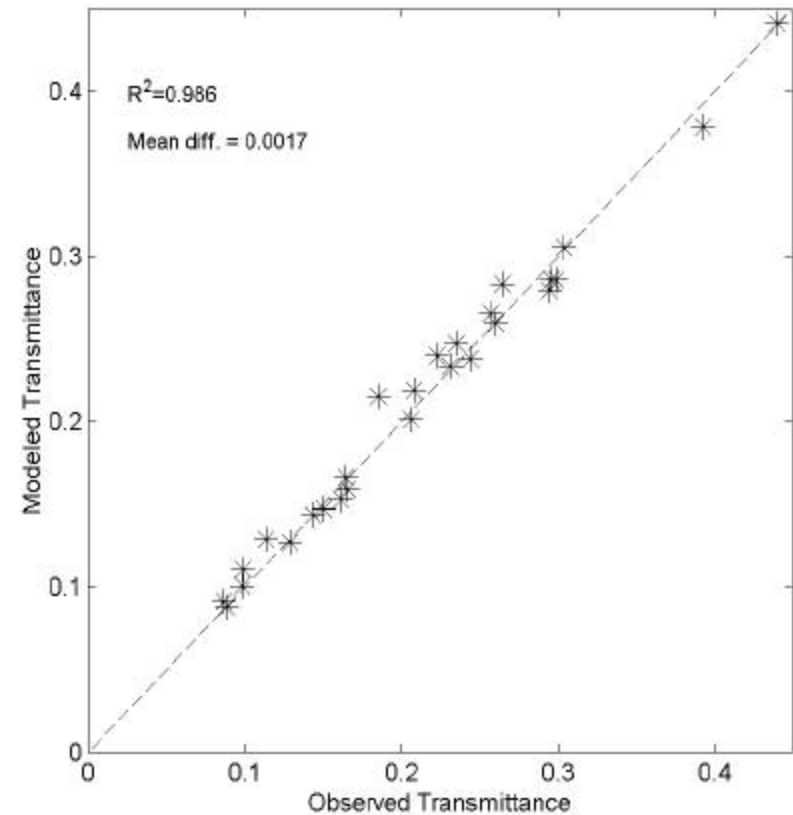
Surface spectral fluxes: RSS (360 -1100 nm, 1024 channels)

Surface broadband fluxes: SIRS (diffuse corrected)

Comparison of transmittance with different surface albedos



Comparison of surface broadband solar transmittance



Li et al. (JGR, 2002)